MV-D1024-TrackCam

User Manual

REV: 1.1

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Index

1. Introduction ... 3
1.1 The MV-D1024-TrackCam ... 4
1.2 Frame Grabber ... 4
2. How To Get Started ... 5
3. Technical Data ... 6
4. Camera Interface ... 7
4.1 Pin Assignments for the MDR26 Socket of the CameraLink Interface ... 7
4.2 Pin Assignments for the Socket of the Voltage Supply Connector ... 7
5. Basic Operation and Features ... 8
5.1 Configuration Interfaces ... 8
5.2 Exposure Control ... 8
5.3 Global Shutter ... 8
5.4 Region of Interest ... 8
5.5 LinLog and Skimming Mode ... 8
5.6 Status Indicator ... 9
6. PFRemote ... 10
6.1 About PFRemote Software ... 10
6.1.1 Getting The Software ... 10
6.1.2 Installing The Software ... 10
6.1.3 Supported Operating Systems ... 10
6.2 Camera Initialization ... 11
6.3 Stored Camera Configuration ... 11
6.4 Exposure and Triggermodes ... 12
6.4.1 Advanced Triggering Modes ... 13
6.5 Window Of Interest ... 14
6.6 MROI / Mask Mode ... 14
6.7 Characteristic Curves And Amplification ... 15
6.8 LUT Editor (Look-up Table) ... 16
6.9 LinLog and Skimming ... 17
6.10 Calibration ... 18
7. Mechanical Dimensions ... 20
8. Important Notes ... 21
8.1 Storage and Transport ... 21
8.2 Declaration of Conformity ... 21
8.3 Package Content ... 22
8.4 Accessories ... 22
9. Service Information ... 23
9.1 Guarantee Conditions ... 23
9.1.1 Guarantee Claims ... 23
9.1.2 Repair Time ... 23
9.1.3 Claims for Damages ... 23
9.1.4 In Case of Damage ... 23
9.1.5 Safety Hints ... 24
10. Literature ... 25
11. Document History ... 26

1. Introduction

High-speed megapixel CMOS camera for fast tracking applications

The MV-D1024-TrackCam from Photonfocus is aimed at demanding applications in fast image processing.

The highlight of this camera is the fast configuration interface. This makes it possible to use a frame-to-frame camera control with up to 40 Mbit/s, instead of the usual 9.6 kbit/s.

The camera provides an exceptionally high dynamic range of up to 120dB at a resolution of 1024 x 1024 pixels and a frame rate of up to 75 full images per second. It is built around a CMOS image sensor that has been specially developed by Photonfocus.

The principal advantages of the Photonfocus CMOS technology are:

1. Low power consumption at high speeds
2. Resistance to blooming, smear, and image lags
3. Extremely high image contrast achieved by LinLog™ technology

With the fast configuration interface, in combination with ROI and LinLog™ technology, Photonfocus offers an absolutely unique product designed for:

- Tracking of fast moving objects
- Simultaneous inspection of different regions
- Shot-to-shot definition of ROI, exposure time and LinLog™ settings
- The MV-D1024-TrackCam is targeted to
- Industrial (welding process, welding inspection, PCB inspection)
- Sport (movement analysis, object tracking)
- Research and development

The compact size of only 55 x 55 x 46 mm³ makes the MV-D1024-TrackCam the perfect solution for applications in which space is at a premium.

With the digital camera series, Photonfocus has proven that the image quality of modern CMOS sensors is now appropriate for a wide range of applications.

Photonfocus is ISO 9001 certified. All products are produced with the latest techniques in order to ensure the highest degree of quality and to satisfy the requirements of our customers.

1.1 The MV-D1024-TrackCam

The *MV-D1024-TrackCam* is a high-end CMOS megapixel camera with global shutter. It has a fast configuration interface that lets you modify the most important camera configuration parameters at speeds up to 40 MBaud.

The camera includes the following features:

- CMOS Progressive scan global shutter, monochrome
- Up to 75 fps full frame rate
- LinLog™ Pixel with up to 120 dB dynamic range
- CameraLink© -Interface
- Internal Lookup Table
- 8 Bit digital resolution
- Region of interest (ROI)
- Skimming: Mode in which small signal gain of a pixel is increased
- Programmable via a high-speed Configuration Interface or an RS-232 serial port
- Designed for frame grabber *microEnableIII-fast configuration* by Silicon Software.
- C-Mount objective mount

1.2 Frame Grabber

The *MV-D1024-TrackCam* is designed to be used with the *microEnableIII-fast configuration* frame grabber from *Silicon Software*. This special frame grabber version accesses the *MV-D1024-TrackCam* via the high-speed configuration interface. The camera is controlled and programmed with the frame grabber software.

However it can be run with any Photonfocus-compliant frame grabber (see [FGLIST] in Literature). In this case the camera can be programmed with the tool *PFRemote* (see chapter 6), but fast configuration is not possible.

2. How To Get Started

1. Remove the camera from its packing and ensure that it is complete and undamaged. If any damage has occurred during transport, please contact the transport company and your distributor immediately.
2. Connect the camera to the microEnableIII-fast configuration frame grabber with a suitable CameraLink© cable.

   Important Note: Only cables can be used where each wire-pair is shielded. Thus the following Phontonfocus cables cannot be used: Part no. 704020.052 and 704020.102.

   Warning: Do not connect or disconnect connections while camera power is on.
3. The camera is delivered with a 3-pole power plug. Ensuring that the maximum operating voltage is not exceeded, connect the camera to a suitable power supply (+5V DC +/-10%).
4. To use the camera in the Fast Configuration mode, please read the “getting started” section of the Silicon Software Fast Configuration manual ([ME_FC]).
5. Additional functions can be programmed with the *PFRemote* tool (see chapter PFRemote) or with Photonfocus *pflib*, delivered with *PFRemote* tool.

3. Technical Data

Technical Data for the MV-D1024-TrackCam	
Number of pixels	1024 x 1024
Pixel size	10.6 µm x 10.6 µm
Optically active area	10.9 mm x 10.9 mm
Optical diagonal	15.42 mm ➔ 1" Standard optics
Objective mount	C-mount
Characteristic	Linear or LinLog™ adjustable
Full well capacity	200 ke$^-$
Sensitivity	10 µJ/m^2/LSB @ 630 nm, 8 bit
Noise	< 0.5 Grey level standard deviation @ 8 bit
Fixed Pattern Noise	< 3 Grey level standard deviation @ 8 bit
Dynamic range in linear mode	> 48 dB @ 8 bit
Dynamic range in LinLog™ mode	> 120 dB
Analog amplification	1 or 4
Spectral range	400 nm – 900 nm (see Fig. 1)
Optical fill factor	35%
Data interface	CameraLink
Data resolution	8 bit, or 9 to 8 bit LUT
Pixel clock	2x40 MHz
Internal pixel clock	4x20 MHz
External clock rate CameraLink interface	10 MHz to 20 MHz
Maximum frame rate	75 fps @ T_{int} = 10 µs
Shutter type	global shutter
Exposure time	1 µs – 0.5 s in steps of 50 ns
Configuration interface	RS232 Standard, 9600 baud, 1 Start bit, 1 Stop bit, no Parity bit
High-Speed configuration interface	Synchronous transmission < 40MBaud, 1 Start bit, 1 Stop bit, no Parity bit
Voltage supply	+5V DC +/-10%
Power consumption	2 W
Dimensions	55 mm (B) x 55 mm (W) x 50 mm (H)
Weight	200g
CE Test	Approved (see chapter 8.2)

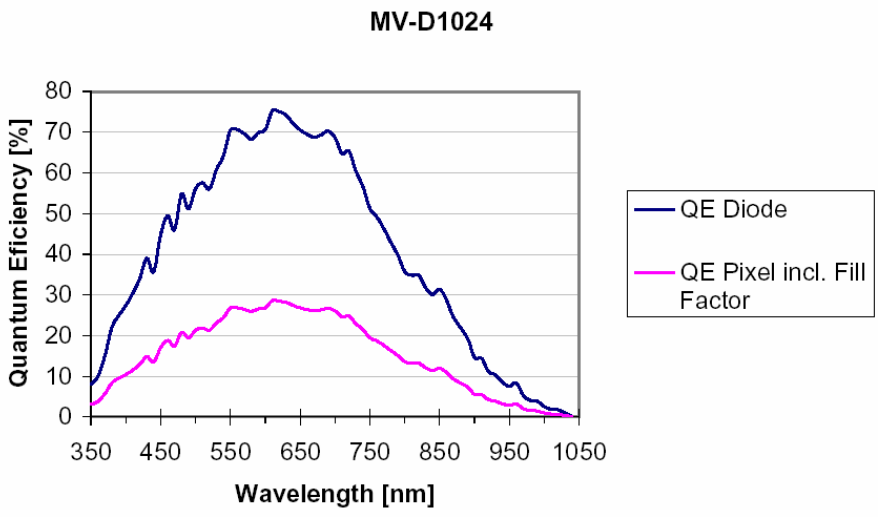


Fig. 1: Quantum efficiency as function of wavelength

4. Camera Interface

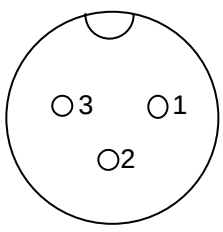
The *MV-D1024-TrackCam* is equipped with a CameraLink interface in the base configuration.

4.1 Pin Assignments for the MDR26 Socket of the CameraLink Interface

PIN	I/O	Name	Description
1	PW	SHIELD	Shield
2	O	N_XD0	Negative LVDS Output, CameraLink Data D0
3	O	N_XD1	Negative LVDS Output, CameraLink Data D1
4	O	N_XD2	Negative LVDS Output, CameraLink Data D2
5	O	N_XCLK	Negative LVDS Output, CameraLink Clock
6	O	N_XD3	Negative LVDS Output, CameraLink Data D3
7	I	P_SERTOCAM	Positive LVDS Input, Serial Communication to the camera
8	O	N_SERTOFG	Negative LVDS Output, Serial Communication from the camera
9	I	N_CC1	Negative LVDS Input, External Trigger signal EXSYNC
10	I	P_CC2	Positive LVDS Output, not used
11	I	N_CC3	Negative LVDS Input, serial clock (Fast configuration interface)
12	I	P_CC4	Positive LVDS Input, data (Fast configuration interface)
13	PW	SHIELD	Shield
14	PW	SHIELD	Shield
15	O	P_XD0	Positive LVDS Output, CameraLink Data D0
16	O	P_XD1	Positive LVDS Output, CameraLink Data D1
17	O	P_XD2	Positive LVDS Output, CameraLink Data D2
18	O	P_XCLK	Positive LVDS Output, CameraLink clock
19	O	P_XD3	Positive LVDS Output, CameraLink Data D3
20	I	N_SERTOCAM	Negative LVDS Input, Serial Communication to the camera
21	O	P_SERTOFG	Positive LVDS Output, Serial Communication from the camera
22	I	P_CC1	Positive LVDS Input, external Trigger signal EXSYNC
23	I	N_CC2	Negative LVDS Input, not used
24	I	P_CC3	Positive LVDS Input, serial clock (Fast configuration interface)
25	I	N_CC4	Negative LVDS Input, data (Fast configuration interface)
26	PW	SHIELD	Shield
S	PW	SHIELD	Shield

4.2 Pin Assignments for the Socket of the Voltage Supply Connector

PIN	I/O	Name	Description
1	PW	VDD	+ 5 V voltage supply
2	PW	GND	Ground
3	PW	VDD2	Reserved



Connector socket Nr. 09-0408-90-03 for the voltage supply

5. Basic Operation and Features

Note: The high-speed interface can be accessed by the *microEnableIII-fast configuration*frame grabber. In this case not all functions described in this section are available or are replaced by default values (see [ME_FC]).

5.1 Configuration Interfaces

The *MV-D1024-TrackCam* can be programmed via a:

- High-speed interface (up to 40 MBaud) that lets you modify important camera configuration parameters with the maximum frame rate. Note: this interface is designed for the *microEnableIII-fast configuration* frame grabber.
- A RS232-interface working at 9600 Baud (included in CameraLink© interface).

5.2 Exposure Control

Note: When using the high-speed interface, exposure is controlled by the *microEnableIII-fast configuration* frame grabber.

Exposure can be controlled by applying external synchronisation signals (see section 6.4). A free-run mode is also available.

5.3 Global Shutter

The sensor used in the *MV-D1024-TrackCam* uses a global shutter, i.e. all pixels are exposed at exactly the same time.

5.4 Region of Interest

With the *MV-D1024-TrackCam* camera, it is possible to increase the image data rate by reading out only a part of the pixel matrix. The user can define a region of interest (ROI) within the sensor to be transmitted to the frame grabber and thus higher frame rates can be achieved.

5.5 LinLog and Skimming Mode

The LinLog™ CMOS image sensor from Photonfocus employed in the *MV-D1024-TrackCam* allows the user to adapt the characteristics of the sensor to the requirements of the application.

- **Linear mode:** For normal applications that do not require high contrast, the sensor can be operated in linear mode.
- **Skimming mode:** For applications having short exposure times and low illumination intensity, it is advisable to activate skim mode, in which a non-linear amplification, similar to a gamma correction, occurs in the pixel so that small signals are amplified significantly more than large signals.
- **LinLog™ mode:** In situations involving high intrascene contrast, compression of the upper grey level region can be achieved with the LinLog™ Technology. At low intensities, each pixel shows a linear response. At high intensities, the response changes to logarithmic compression. The transition region between linear and logarithmic response can be smoothly adjusted and is continuously differentiable.

Skimming and LinLog™ can be combined to achieve maximum control of the sensor output. Please refer to application note [AN001] for detailed information on the setting of LinLogTM.

5.6 Status Indicator

A two color LED on the rear of the camera indicate the camera status to the user. In normal operation the LED lights green when an image is being produced. At low frame rates a flickering can be observed that changes to a continuous light at high frame rates. Since the light intensity is dependent on the relation between exposure time and read-out time, the light from the LED can practically disappear when using small ROI and long exposure times.
A red LED indicates that serial communication on the RS232-interface is active.

6. PFRemote

6.1 About PFRemote Software

The *MV-D1024-TrackCam* can be programmed with the tool *PFRemote* which uses the CameraLink© RS232-interface.

Note: To use the high-speed configuration interface you need the *microEnableIII-fast configuration* frame grabber from *Silicon Software*. Please refer to the frame grabber manual ([ME_FC]). In this case the camera is programmed by the frame grabber software. However there are functions that can only be programmed by *PFRemote* software.

Warning: Do not use *PFRemote* while using the high-speed interface!

6.1.1 Getting The Software

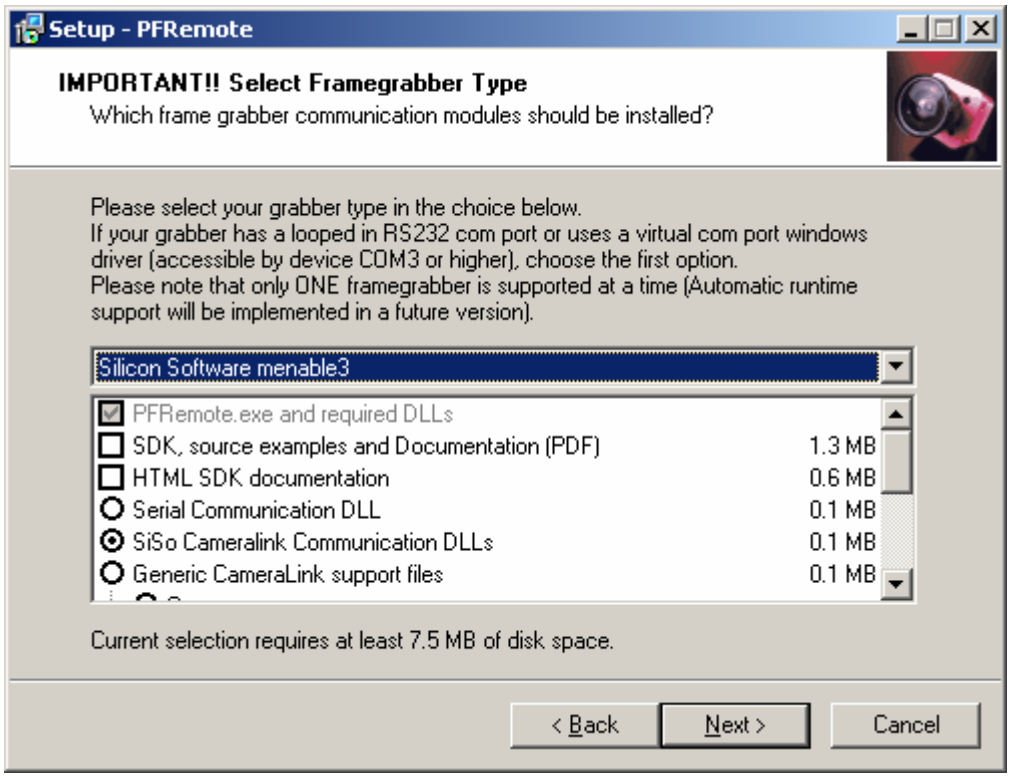
The latest version of the *PFRemote* software can be downloaded at:

http://www.photonfocus.com/html/eng/support/software.php

6.1.2 Installing The Software

Run the *PFRemote_SDK* executable to start an installation wizard which guides you through the installation.

Framegrabber selection: Select *Silicon Software menable3* from the drop-down list.


Setup - PFRemote
IMPORTANT!! Select Framegrabber Type
Which frame grabber communication modules should be installed?
Please select your grabber type in the choice below.
If your grabber has a looped in RS232 com port or uses a virtual com port windows driver (accessible by device COM3 or higher), choose the first option.
Please note that only ONE framegrabber is supported at a time (Automatic runtime support will be implemented in a future version).
Silicon Software menable3
PFRemote.exe and required DLLs
SDK, source examples and Documentation (PDF) 1.3 MB
HTML SDK documentation 0.6 MB
Serial Communication DLL 0.1 MB
SiSo Cameralink Communication DLLs 0.1 MB
Generic CameraLink support files 0.1 MB
Current selection requires at least 7.5 MB of disk space.
< Back
Next >
Cancel

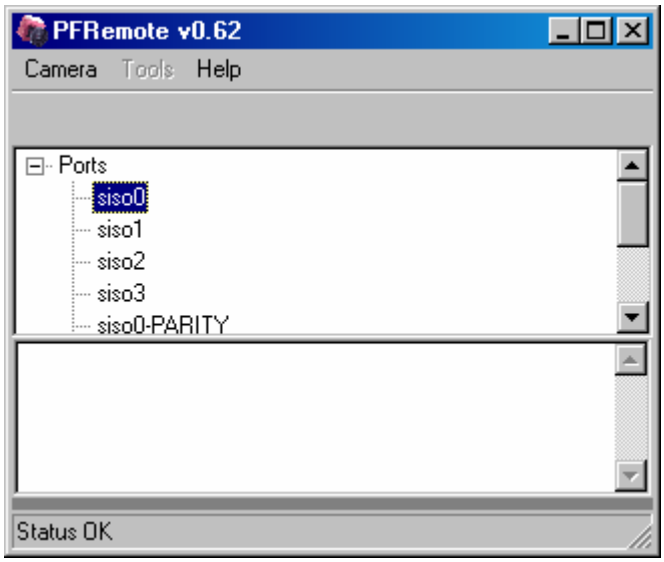
6.1.3 Supported Operating Systems

- Windows 2000, Windows XP

6.2 Camera Initialization

On start, PFRemote displays a list of available communication ports (see figure below).

Double-click on siso0 if your camera is connected to the input A of the Silicon Software framegrabber, double-click on siso1 if your camera is connected to the input B.



Once the camera has successfully been opened, the camera type is displayed. Further options appear on right click on the camera entry:

Info	Shows some camera information
Reset	Resets the camera
Close	Closes camera and frees communication port

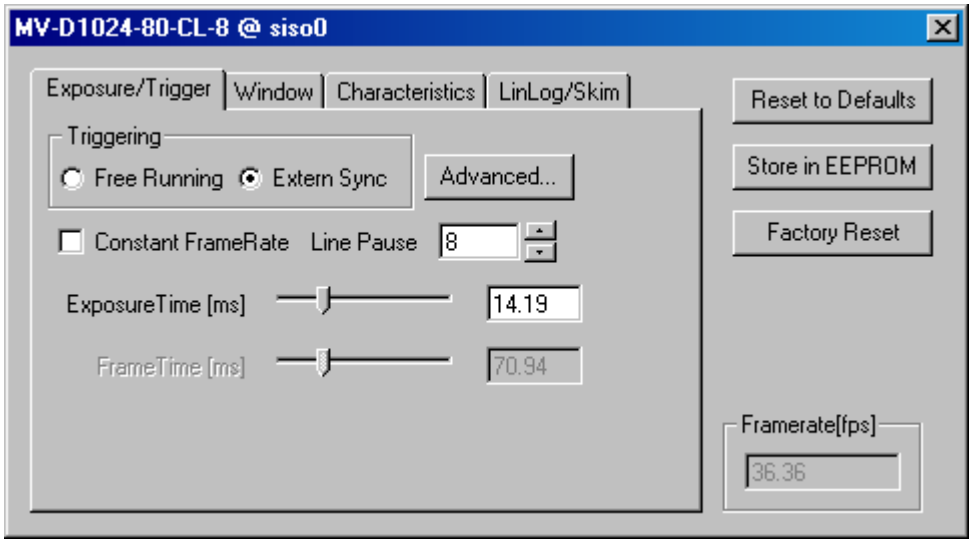
6.3 Stored Camera Configuration

This section describes the buttons that appear on the right hand side of the *PFRemote* window, please see also application note [AN004].

Reset to Defaults	Resets the camera and re-reads default (EEPROM) values into the configuration dialog box.
Store in EEPROM	Store current settings in EEPROM as boot-up values.
Factory Reset	Recover factory settings from EEPROM. This can take some time.

Please note: Some configuration parameters such as LinLog™ and Skimming values can not be read out, therefore the displayed values might not be correct. To make sure the display is synchronized, you have to reset the camera manually via the **Reset to Defaults** button.

6.4 Exposure and Triggermodes



Free Running Free Running Mode; the camera generates consecutive frames whose rate is determined by the set exposure time resp. frame time.

Extern Sync External synchronization through EXSYNC signal.

Advanced Set advanced triggering modes (see below)

Constant FrameRate For free-running mode only: If this flag is set, the frame rate is determined by the frame time which can be set below. Otherwise, the camera will immediately deliver another frame after the sensor exposure.

LinePause This is the horizontal blank time in number of pixel clock cycles. Some frame grabbers require larger numbers than the standard default 8 (fastest). If your frame grabber displays artefacts, increase **LinePause.**

Exposure Time Exposure time in milliseconds. The slider allows to choose a value within the camera's possible range in a nonlinear way. Note that the frame time slider may be adjusted if the chosen exposure time requires so - read below

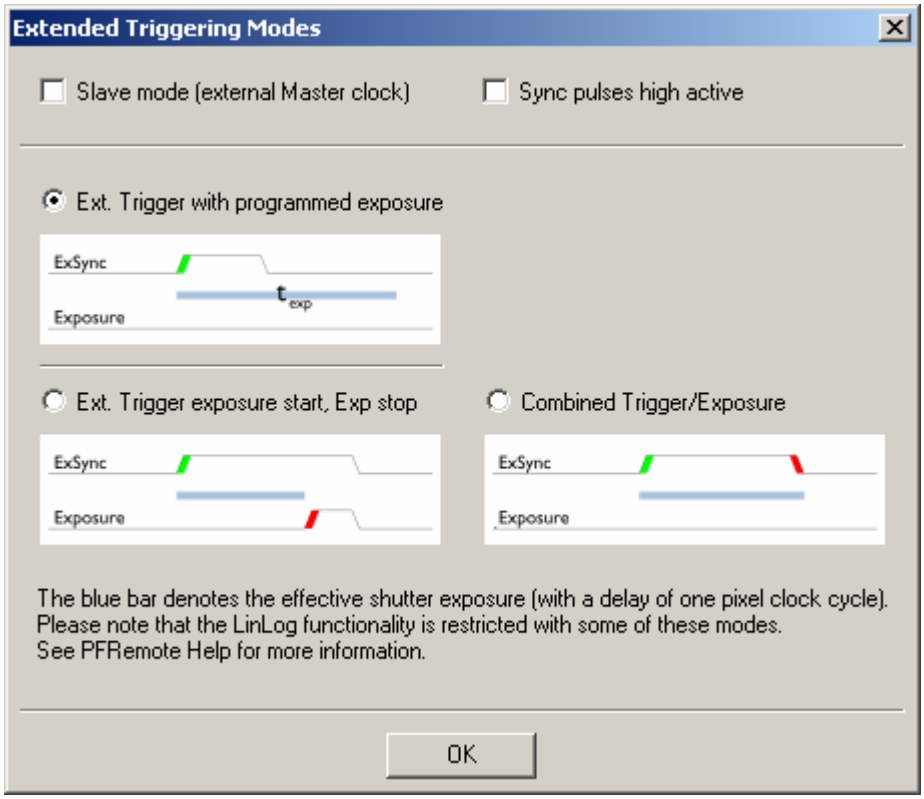
Frame Time If **Constant FrameRate** is set, the frame rate is determined by the given frame time in milliseconds. Note that, if this time is less than the exposure time, the Exposure Time slider will be adjusted.

Frame Rate The calculated frame rate in frames per second [fps]

The frame rate display is updated whenever a relevant value is changed. This value can not be edited (use frame rate slider and Constant FrameRate mode for precise frame rate control).

6.4.1 Advanced Triggering Modes

Important: There are restrictions on the LinLog™ functionality with some triggering modes, except *Ext. Trigger with programmed exposure*. In all other cases, the COMP value must be set to 0.0 in order to have LinLog™ work correctly. Other values may show no effect.


Extended Triggering Modes
Slave mode (external Master clock)
Sync pulses high active
Ext. Trigger with programmed exposure
ExSync
Exposure
t exp
Ext. Trigger exposure start, Exp stop
Combined Trigger/Exposure
The blue bar denotes the effective shutter exposure (with a delay of one pixel clock cycle).
Please note that the LinLog functionality is restricted with some of these modes.
See PFRemote Help for more information.
OK

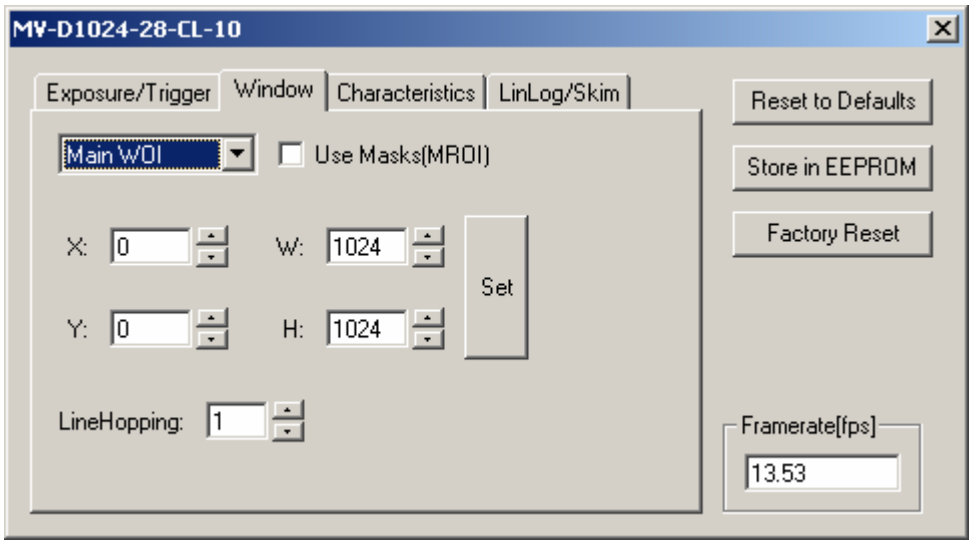
Slave mode	External Master clock synchronization via the MCLK wires.
Sync pulses high active	This is the default. If deselected, the trigger signals must be inverted (and the schemes below must be thought inverse as well)
Ext. Trigger with programmed exposure	On sync pulse start, the programmed exposure (slider *ExposureTime*) begins.
Ext. Trigger exposure start, Exp stop	Not available in TrackCam.
Combined Trigger/Exposure	The length of the ExSync pulse determines the exposure time.

6.5 Window Of Interest

The Window Of Interest (**WOI**) (also called region of interest) is defined as a rectangle [x, y, w, h] where

x	X coordinate of upper left corner, starting with 0
y	Y coordinate of upper left corner, starting with 0
w	Width of window
h	Height of window

The rows and columns are counted beginning at 0, i.e. the last row and the last column have the address 1023.



Please note that certain restrictions apply to the start and stop value of horizontal direction (X):

If this is not the case, the **LinePause** value is automatically increased to avoid image artefacts.

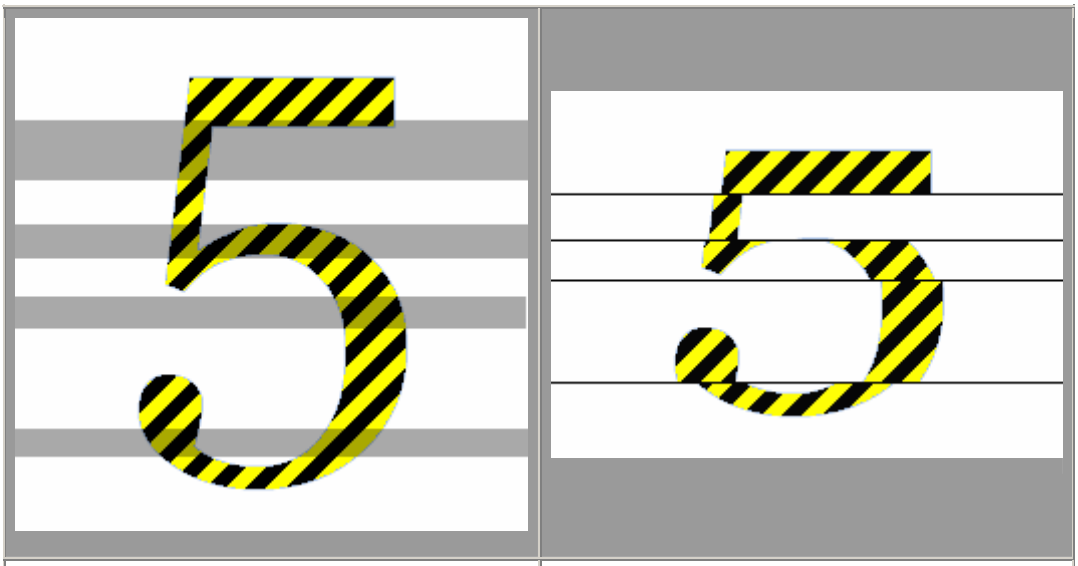
The **LineHopping** attribute defines the line readout stepping. For example, a number of 2 skips all odd lines.

6.6 MROI / Mask Mode

When activated, the MROI mode applies a maximum number of 16 masks to the current window of interest. A mask is defined as a range of scan lines which are skipped and not read out which further speeds up the image acquisition. Note that mask windows may not overlap and are not checked for sanity. The parent window (Main WOI) **must** include the first mask, but may exclude trailing, unused masks.

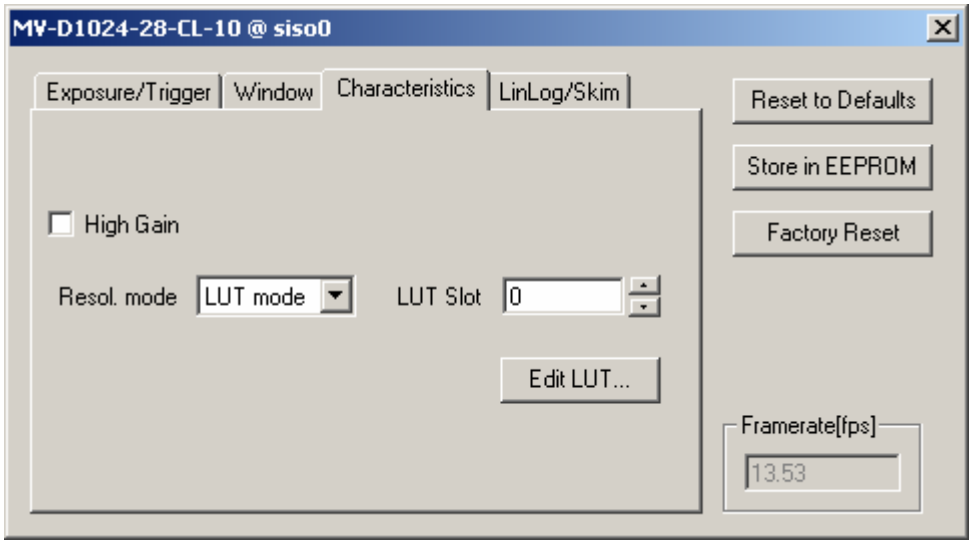
A mask is defined by its Y start value and the height H. These are entered analogous to the main ROI.

As an example, the greyed out areas on the 'zebra 5' denote the mask areas. The read out result in the frame grabber is displayed on the right (the black lines are just displayed to better visualize the seams).



Picture with 4 masks	Resulting 5 image stripes

6.7 Characteristic Curves And Amplification



High Gain Toggle High Gain amplification.

Resolution Choose camera ADC resolution (bit depth), LUT or LFSR (Random test pattern).

LUT slot Switch to LUT number *n*

Edit LUT Open LUT editor window (see below)

6.8 LUT Editor (Look-up Table)

The LUT editor allows to create look-up tables which digitally re-map intensity values to other values. The value conversion is directly done on the camera, whereas an input range [0, n] (n according to camera bit depth) is mapped to a output range of [0, 255].

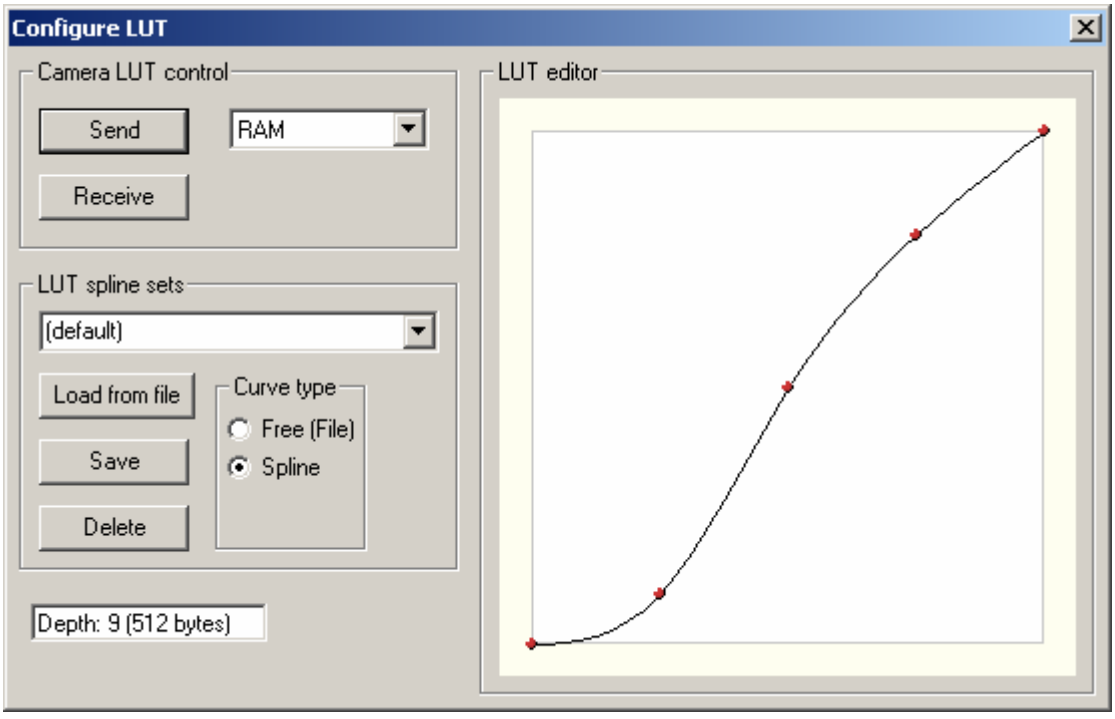
The LUT editor displays either spline curves or free points (whereas the free point display is not very accurate, since the input values can cover a greater range than the canvas display's size in x).

The input range is [0 ... 511].

Editing of the LUT curve happens by dragging the control points in Spline mode or simply painting on the window in Free mode. Once the curve is ready to be uploaded, you should first test it in the camera's RAM (Default).

Pressing **Send** uploads the LUT data to the camera (which can take some time, depending on the frame grabber dependant implementation of the serial communication). If LUT mode is not enabled, it is automatically turned on.

The LUT finally can be stored in one of the [m] available EEPROM slots of the camera by selecting the destination with the chooser right next to the **Send** button.



Further, LUT tables can be downloaded (**Receive**) from the camera and stored to disk.

Depending on the curve mode, the curve parameters are either

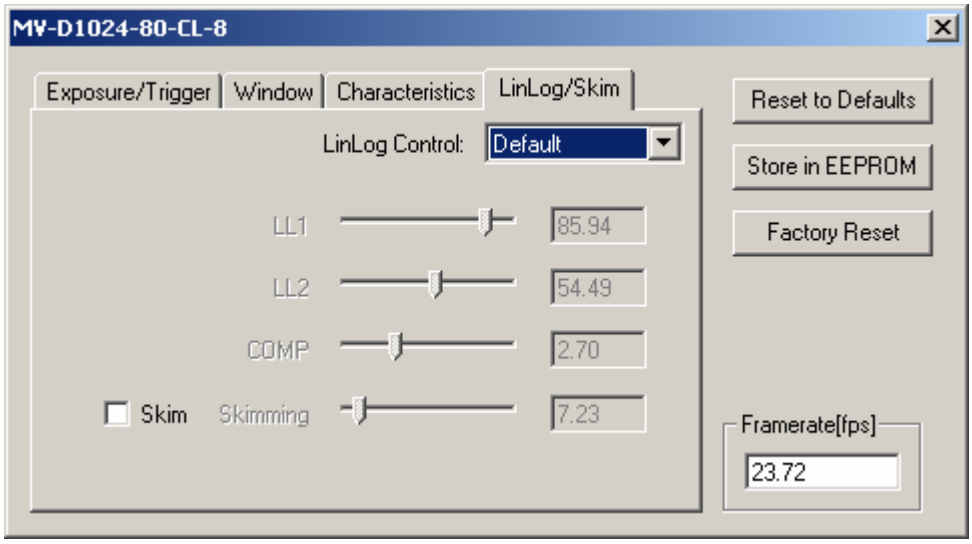
[Spline mode]: Saved in a LUT spline set by entering the setting name in the LUT spline sets choice and pressing **Save**

[Free mode]: Saved in a readable ascii hex code dump file.

If in spline mode, a set simply can be chosen from the drop down choice. Entries can be erased with the Delete button.

6.9 LinLog and Skimming

The LinLog™ feature provides a semi-logarithmic, adjustable behaviour of the camera characteristics, so that extreme white intensities can be monitored without saturation while keeping optimum resolution on dark areas.



Note that the LinLog state might not be known to the application after opening the camera configuration dialog. Therefore, the LinLog Control choice displays "**Default**". Use this choice to turn LinLog off or explicitely on, or reset the camera (**Reset to Defaults**) to update the current default settings.

The Skimming slider is only accessible after a explicit update of the settings.

Quick steps for LinLog™ adjustment (refer to application note [AN001]):

Choose LinLog Control: **LinLog2**. **Default** stands for the default setting which is only well defined if the camera is reset, since LinLog values can not be read back. The LinLog setting makes only use of the **LL1** parameter; see below.

Set the LinLog high compression **LL1** to a value such that your maximum intensity spot in the image resolves well or just starts to show bright gray.

Set the low compression **LL2** to a value *less* than **LL1**.

Fine tune the **COMP** fraction value around small values in the range of [0, 100] to achieve an image with optimum dynamical resolution in high intensity ranges. This may require some iteration through the settings.

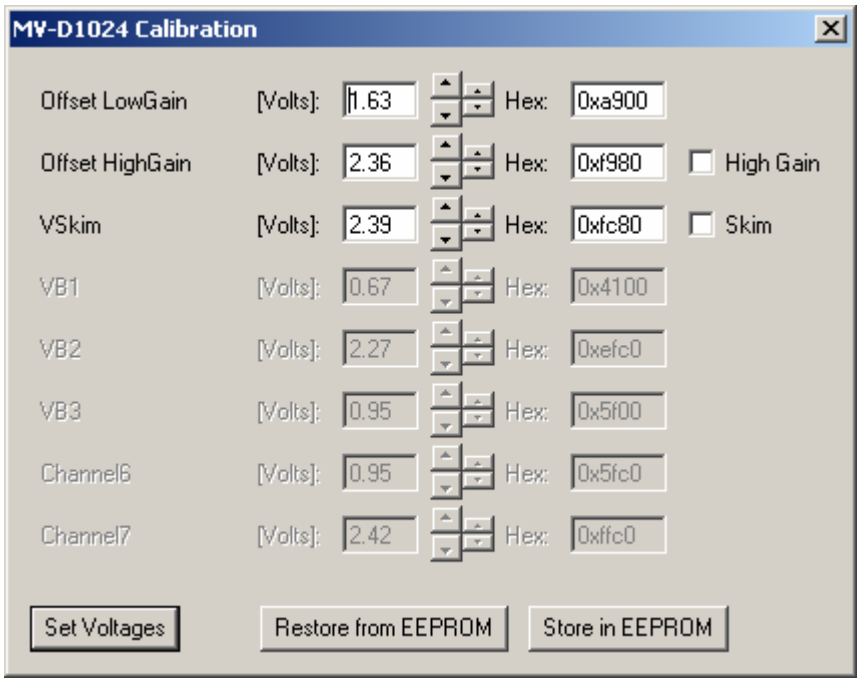
The Skimming mode allows to brighten up darker areas (non-linear).

6.10 Calibration

Normally, the camera does not need to be calibrated as this is done after manufacture. In some cases recalibration or detuning by purpose might be desired.

The calibration dialog is called via the Menu **Camera->Calibration.**

Voltage changes can always be undone by restoring the factory defaults via the configuration dialog.


MV-D1024 Calibration
Offset LowGain [Volts]: 1.63 Hex: 0xa900
Offset HighGain [Volts]: 2.36 Hex: 0xf980 High Gain
VSkim [Volts]: 2.39 Hex: 0xfc80 Skim
VB1 [Volts]: 0.67 Hex: 0x4100
VB2 [Volts]: 2.27 Hex: 0xefc0
VB3 [Volts]: 0.95 Hex: 0x5f00
Channel6 [Volts]: 0.95 Hex: 0x5fc0
Channel7 [Volts]: 2.42 Hex: 0xffc0
Set Voltages
Restore from EEPROM
Store in EEPROM

Entries which are greyed out can not be changed by the user.

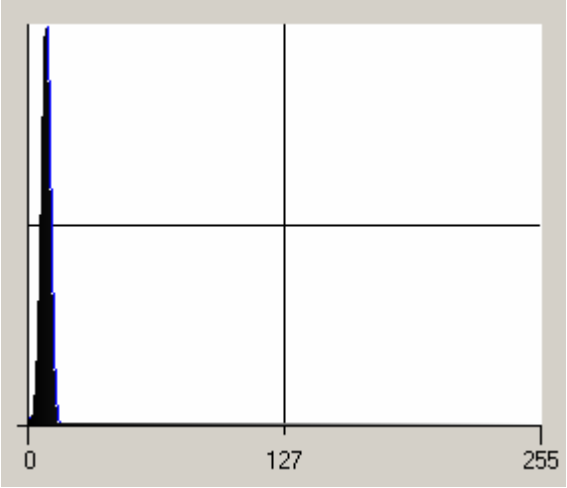
Offset LowGain The black level offset voltage for the LowGain setting (i.e. HighGain off

Offset HighGain Black level offset voltage for HighGain setting

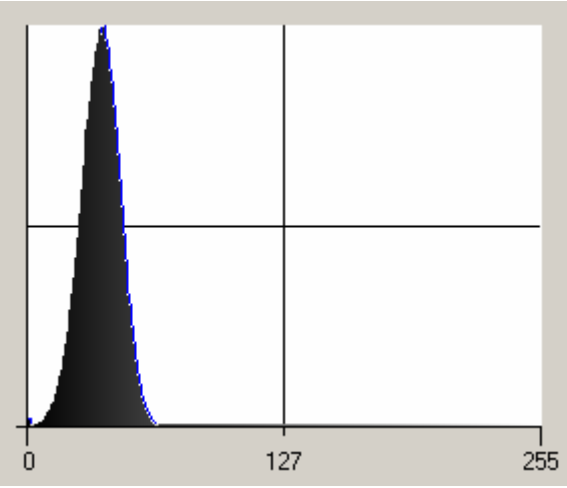
For calibration, you need a frame grabber software with real time histogram functionality. It is also possible to do the calibration by looking at the minimal gray value of the grabbed image.

The standard procedure:

1. Make sure that the sensor is receiving no more light by either covering the C mount with the usually included protection cap or by closing the iris of the C mount lens. Set camera exposure time to minimum.
2. Make sure that HighGain is turned off and change the LowGain offset voltage such that the black level peak displays as in the left image below.
3. Same for HighGain: Activate HighGain via the check box and change the offset such that the black level distribution looks like in the image on the right.
4. Store the values in the EEPROM via the **Store in EEPROM** button.



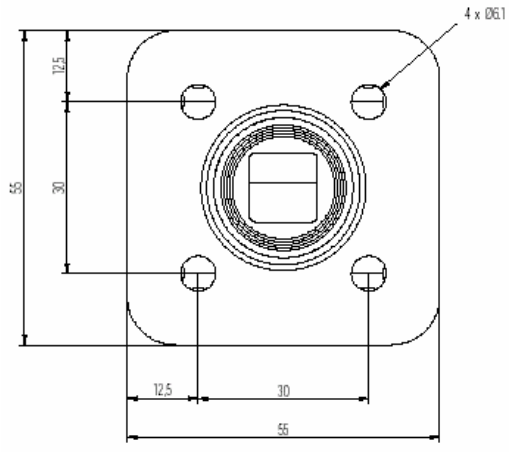
LowGain mode histogram

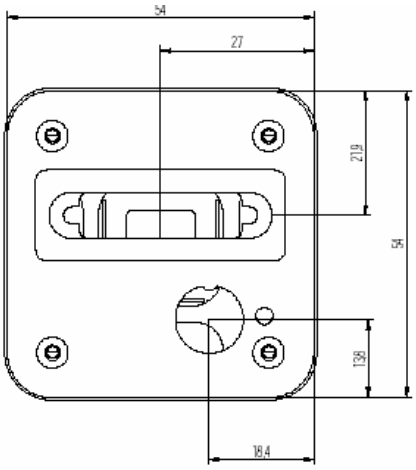


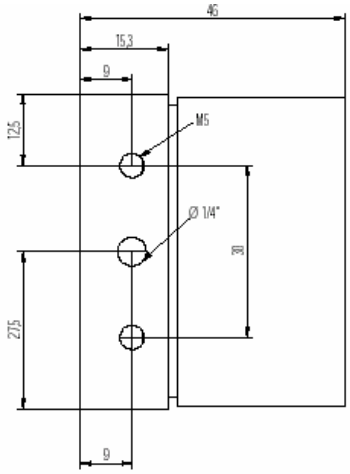
HighGain mode histogram

The Skimming is normally changed in the LinLog panel but can be changed here as well, if the camera is run in skimming mode by default. In this case, the offset voltage may need to be adjusted. Note that the skimming effect is reverse to the voltage, i.e. higher voltage means: less skimming. Note that with too low skimming voltage settings, the image may no longer look good. **Handle with care.**

7. Mechanical Dimensions







8. Important Notes

Photonfocus reserves the right to make changes to its products without notice. Photonfocus products are neither intended nor certified for use in life support systems or in other critical systems. The use of Photonfocus products in such applications is forbidden. Photonfocus, LinLog, LinLog2 and CameraLink are registered trademarks in Switzerland and in other countries.

8.1 Storage and Transport

During storage and transport, the camera should be protected against vibration, shock, moisture and dust. The original packing protects the camera adequately from vibration and shock during storage and transport. Please either retain this packing for possible later use or dispose of it according to local regulations.

8.2 Declaration of Conformity

We, the manufacturer

Photonfocus AG,
Bahnhofplatz 10
CH 8853 Lachen
Switzerland Europe

hereby declare that the products of the camera MV-D1024-TrackCam, released in 2004, conforms to the following standards or other normative documents:

- EN61000-6-2 (2001)
- EN61000-6-3 (2001)
- EN61000-4-2 (1995)
- EN61000-4-3 (1996)
- EN61000-4-4 (1995)
- EN61000-4-6 (1996)
- EN55022 (1994)

This declaration becomes void in case of any changes on the product without written authorization by Photonfocus.

8.3 Package Content

The package includes the following:

- Camera
- Lens protective cap
- enclosing note
- Power supply connector

Photonfocus reserves itself the right to change the content at any time without indication of reasons.

8.4 Accessories

For the camera MV-D1024-TrackCam are several accessories available. For detailed information about the listed parts refer to the Photonfocus Web page www.photonfocus.com.

- CLB 26 Digipeater – CameraLink Repeater for extended cable length
- CameraLink cables
- Power supply

9. Service Information

For product enquiries and quotations, please contact one of our distributors in your area.

A list of distributors can be found on our web-site:

www.photonfocus.com

Product information, documentation and software updates can also be found on our web-site.

9.1 Guarantee Conditions

9.1.1 Guarantee Claims

The manufacturer alone reserves the right to recognize guarantee claims. The guarantee will be rendered null and void in the event of unauthorized manipulation, mechanical damage or damage arising from inappropriate use or from mechanical or electrical modifications, especially soldering. The guarantee will also be invalidated if the apparatus is used for purposes for which it was not designed, if it is incorrectly connected or if it is not used according to the operating instructions.

Guarantee work can only be assured and carried out by the manufacturer.

9.1.2 Repair Time

Repair time will normally be a maximum of 10 working days for repairs to a device for which a legitimate guarantee claim is made.

9.1.3 Claims for Damages

Claims for damages of all kinds, especially those arising from use, are excluded. Liability is limited, in all cases, to the value of our product.

9.1.4 In Case of Damage

If the equipment is defective, return it, in the original packing and with a copy of the receipt, to the following address:

Photonfocus AG
Bahnhofplatz 10
CH-8853 Lachen

Important: Include a written description of the fault as well as your full postal address. The equipment will be forwarded in your name to the service department and, in the event of a legitimate guarantee claim, returned to you without freight charges.

9.1.5 Safety Hints

The apparatus conforms with approved electro-magnetic standards. Opening the apparatus is not permitted. Furthermore, all guarantee claims will be invalidated by inappropriate use. In all circumstances, the following should be noted:

- The apparatus may only be used for the purpose described.
- The apparatus is only suitable for indoor use. Protect it from moisture and heat.
- The permitted operating temperature range is 0°C to 60°C.
- Never attempt repairs yourself. Repairs may only be carried out by trained expert staff.
- Moreover, every piece of equipment is tested before delivery and has a guarantee symbol attached.
- For cleaning purpose, use only a dry soft cloth. Never use water or chemicals.

10. Literature

[AN001] Application note AN001 “LinLog 2” found on
http://www.photonfocus.com/html/eng/support/applicationNotes.php

[AN004] Application note AN004 “Reset Strategies” found on
http://www.photonfocus.com/html/eng/support/applicationNotes.php

[FGLIST] Frame grabber compatibility list
http://www.photonfocus.com/html/eng/support/framegrabbers.php

[ME_FC] User Manual for *microEnableIII-fast configuration* frame grabber, Silicon Software (http://www.siliconsoftware.de)

11. Document History

Document revisions

REV	Changes	Date
1.0	First revision	2004-05-17
1.1	Added note that mode “ext. trigger, exposure start, Exp stop” is not available. Slight modifications in Getting started chapter	2004-07-07